

La Niña and the Upcoming 2010-2011 Winter Season

Mike Baker
National Weather Service
Boulder, Colorado



A satellite image of Earth from space, showing the Americas and the surrounding oceans. The text "Status of La Niña" is overlaid in red. The image shows the Western Hemisphere, with North and South America visible. The Pacific Ocean is to the west, and the Atlantic Ocean is to the east. Cloud patterns are visible over the oceans.

Status of La Niña

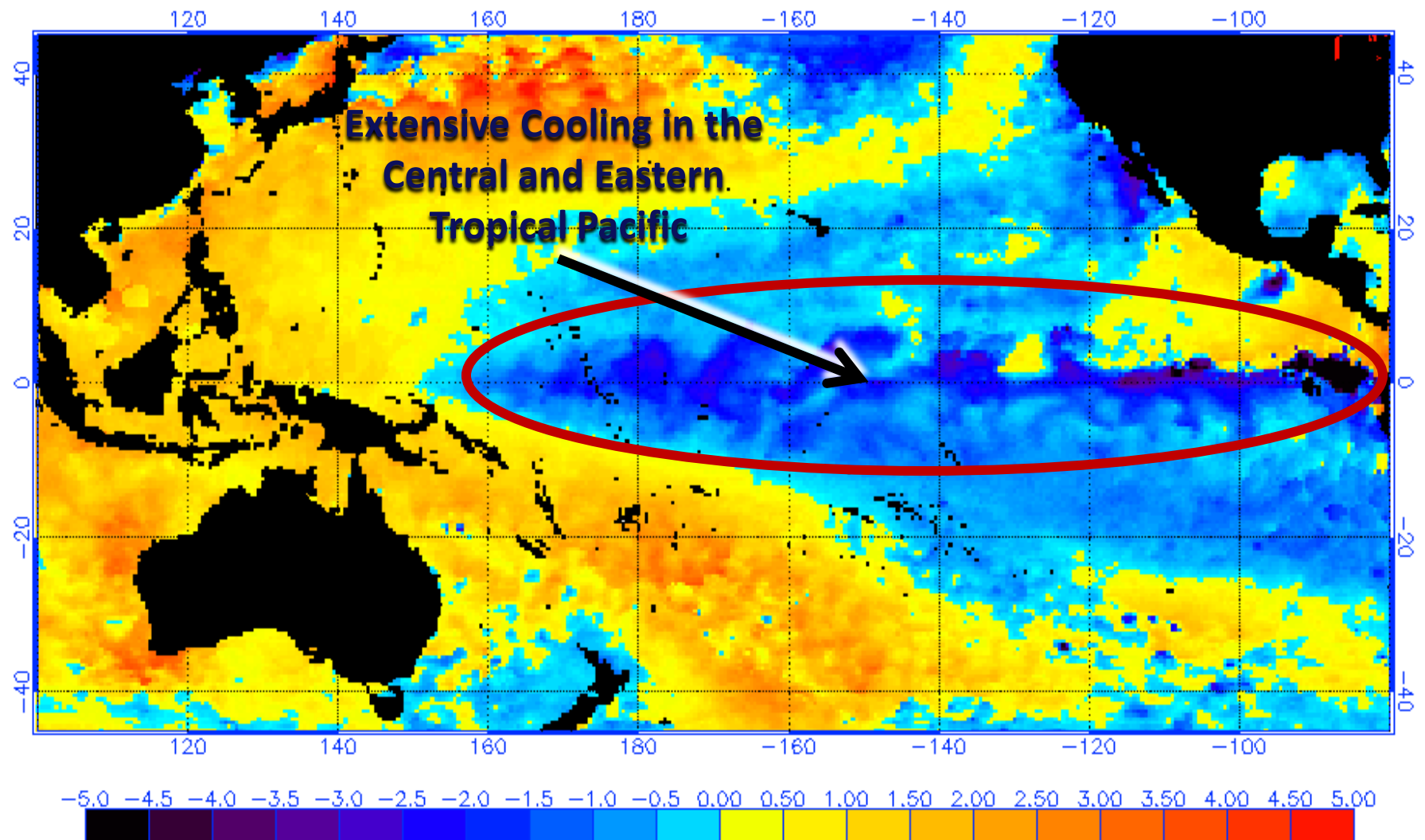
Overview

- **La Niña conditions persist in the central and eastern tropical Pacific Ocean.**
- **Sea surface temperatures (SSTs) in the tropical Pacific from near the International date line to the west coast of South America have ranged from -0.5C to -2.0C below average since late September.**
- **Recent Equatorial Pacific SST trends and model forecasts indicate that this La Niña will strengthen in the next couple of months and will continue at least through the Northern Hemisphere spring of 2011.**

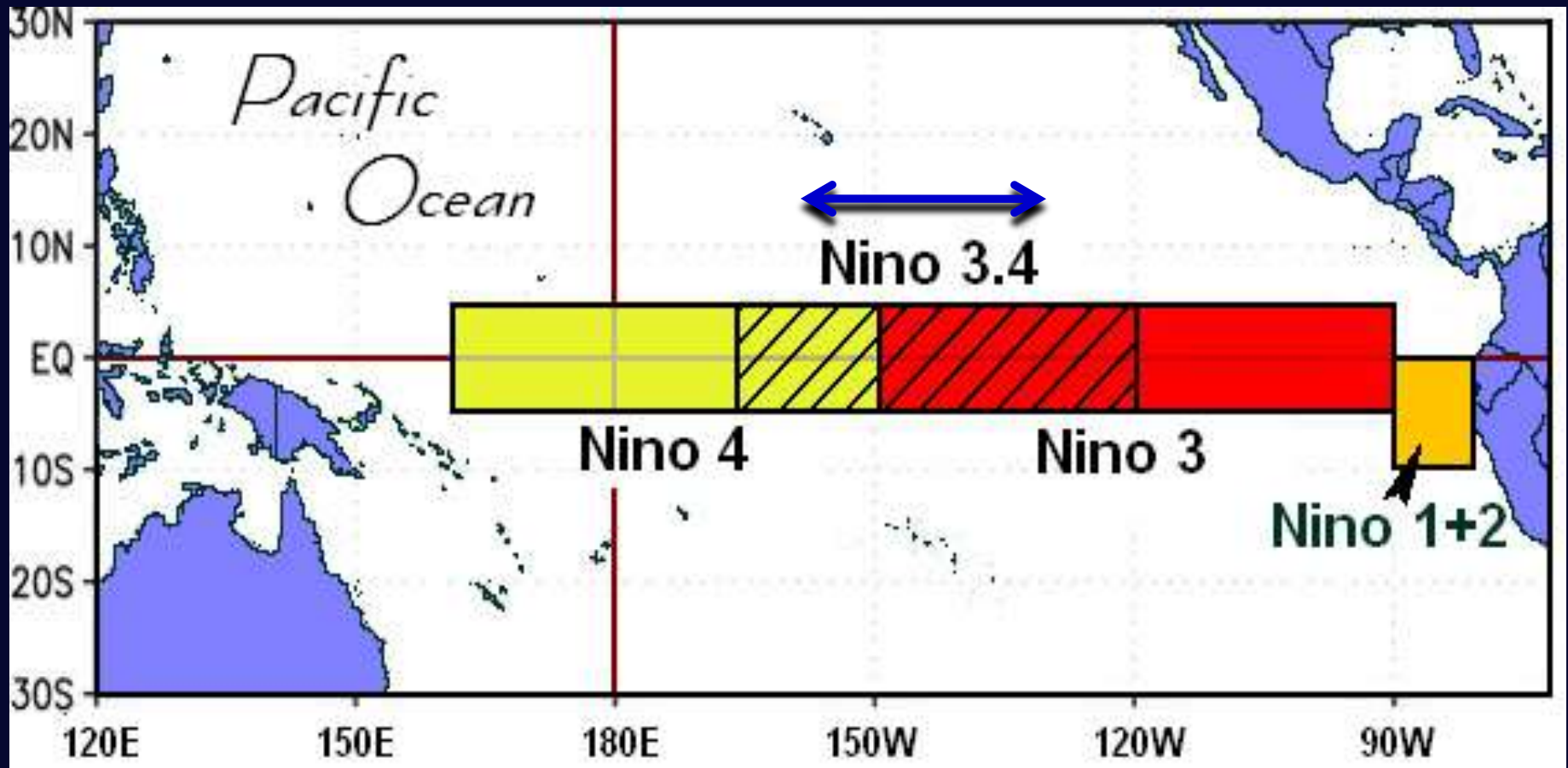
Overview

- **However, there remains some disagreement among the models over the eventual strength of this La Niña. A majority of the 23 climate models (dynamical and statistical models) predict a moderate-to-strong La Niña for the Northern Hemisphere winter.**
- **Given the strong cooling observed in the central and eastern Tropical Pacific over the last few months and the apparent ocean-atmosphere coupling (positive feedback), the outcome offered by the majority of the models is favored at this time.**

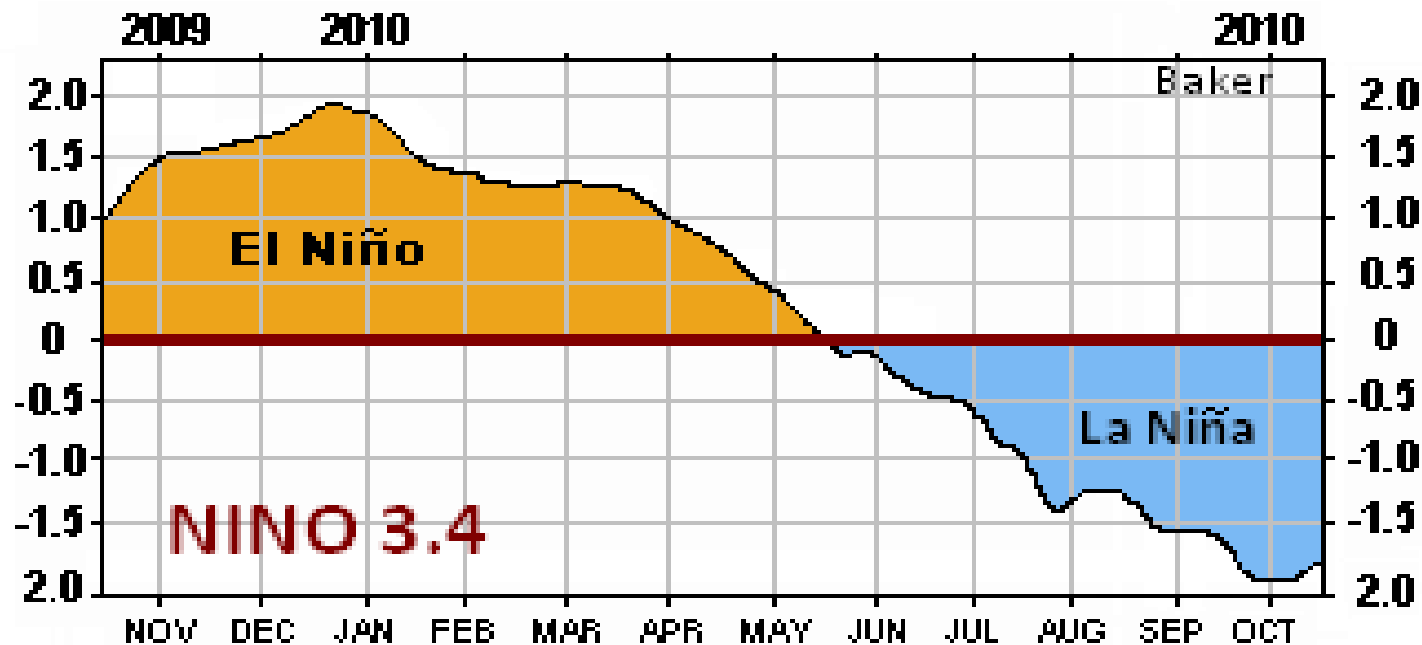
NOAA/NESDIS SST Anomaly (degrees C), as of 10/21/10



Niño Regions in the Tropical Pacific Ocean



Niño 3.4 – The principal region in the eastern tropical Pacific used by the Climate Prediction Center (CPC) for monitoring, assessing and predicting ENSO.

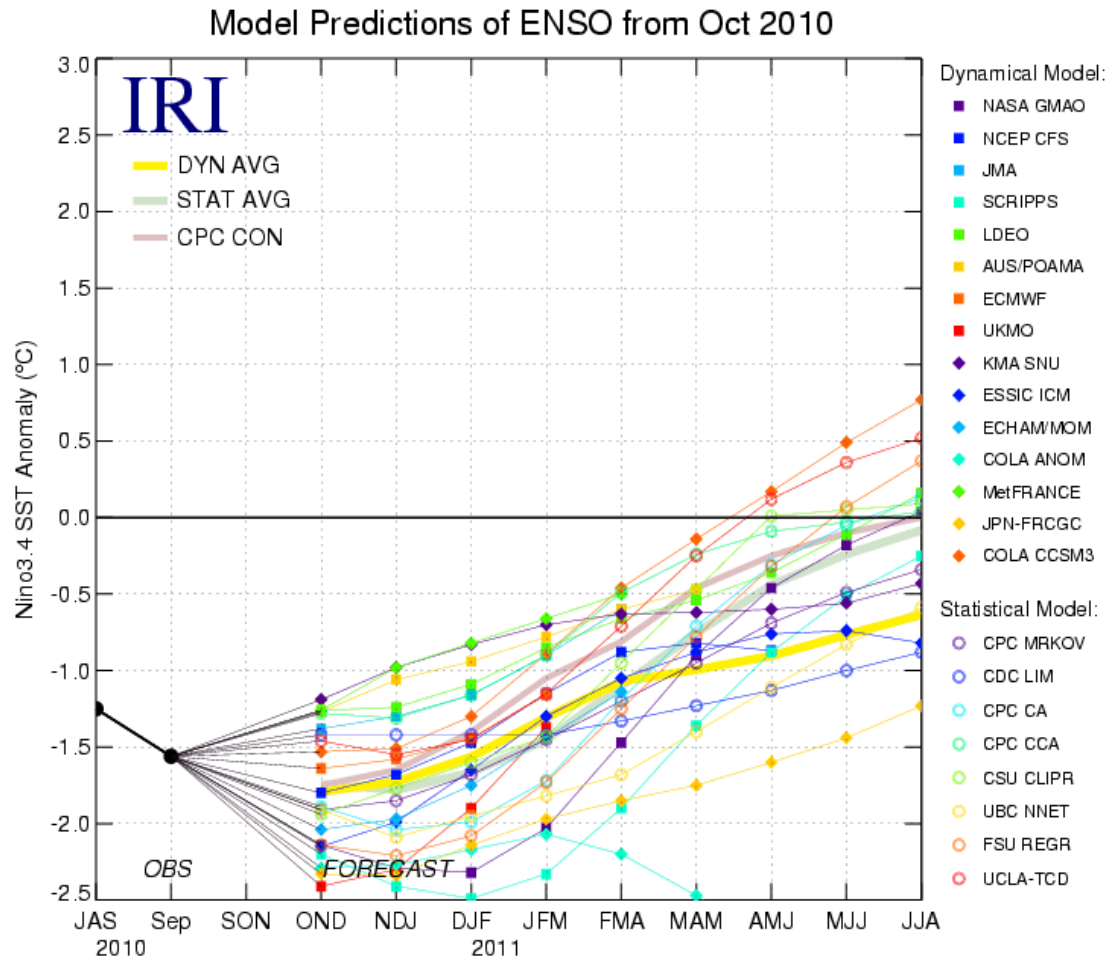


**SST Anomaly (degrees C) for NINO 3.4
as of Oct 15, 2010**

Source: NOAA/Climate Prediction Center

Abnormally cool sea surface temperatures (SSTs) in NINO 3.4 observed late last summer and early this fall are consistent with the development of a La Niña. SSTs have continued to cool with minor rises along the way. As of October 15, the average SSTa for Niño 3.4 was -1.5°C .

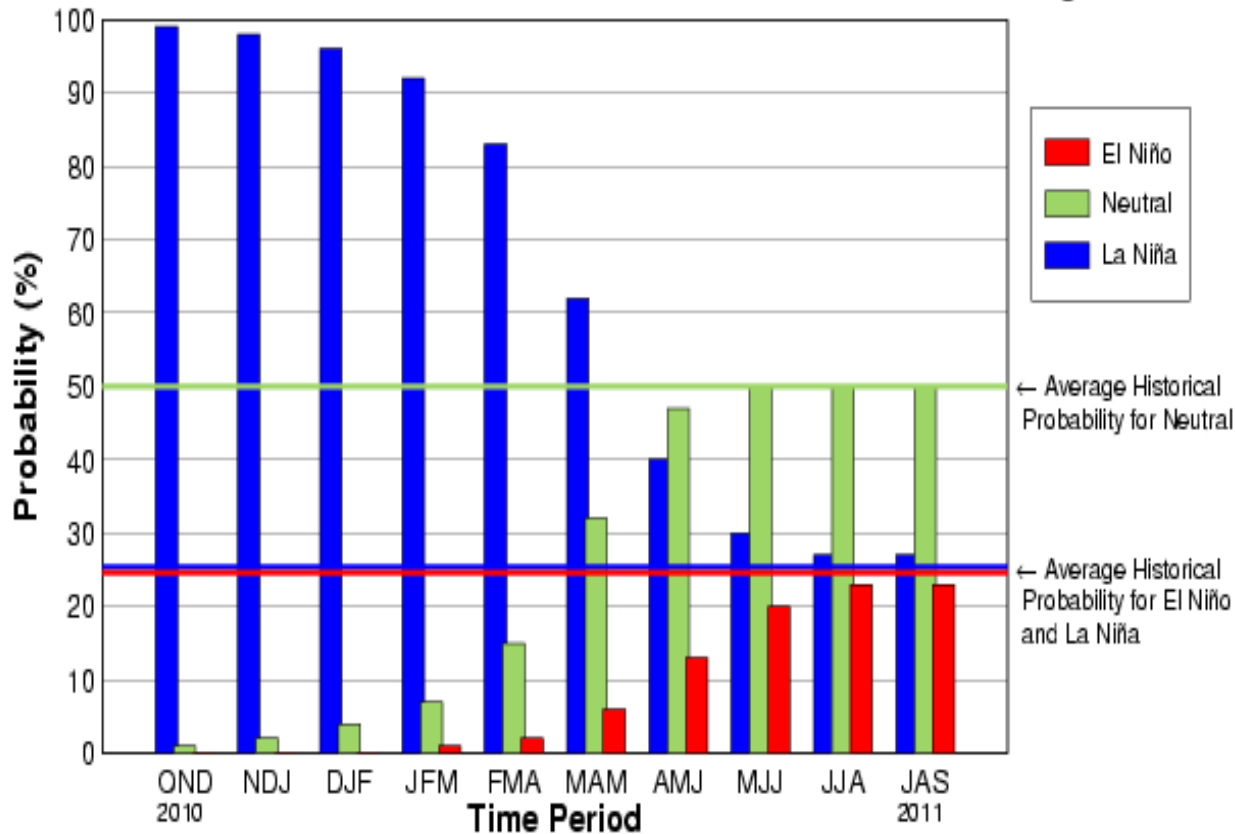
Pacific Niño 3.4 ENSO Outlook



Source: IRI - International Research Institute for Climate and Society Oct. 2010

- All 23 dynamical and statistical models indicate that La Niña conditions (Niño-3.4 SST anomalies - 0.5°C or less) will persist into the Northern Hemisphere spring of 2011. A majority of the models forecast La Niña to strengthen during the next few months, with many of those indicating a strong La Niña by the November-December-January climate season.

IRI Probabilistic ENSO Forecast for NINO3.4 Region



Oct. 2010

This table from IRI shows a greater than 90% probability that the current La Niña will persist in the Niño 3.4 Region at least through the 2011 January-February-March climate period.

Issued Aug 2010

The probability of La Niña, El Niño and non-ENSO or neutral conditions for the next nine 3-month climate periods

Oceanic Niño Index (ONI)

- The **ONI** is based on SST departures from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing, and predicting ENSO.
- Defined as the three-month running-mean SST departures in the Niño 3.4 region.
- Used to place current events into a historical perspective
- **NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.**

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a **positive** ONI greater than or equal to $+0.5^{\circ}\text{C}$.

La Niña: characterized by a **negative** ONI less than or equal to -0.5°C .

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed $\pm 0.5^{\circ}\text{C}$ along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1	-0.8	-0.6	-0.5	-0.4	-0.4	-0.4	-0.5	-0.6	-0.7
2001	-0.6	-0.5	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0	-0.1	-0.1
2002	-0.1	0.1	0.2	0.4	0.7	0.8	0.9	1	1.1	1.3	1.5	1.4
2003	1.2	0.9	0.5	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	0.5	0.7	0.8	0.9	0.8	0.8	0.8
2005	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	0.5	0.6	0.9	1.1	1.1
2007	0.8	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	-0.7	-1	-1.1	-1.3
2008	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0	0	0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	-0.6	-1.0	?			

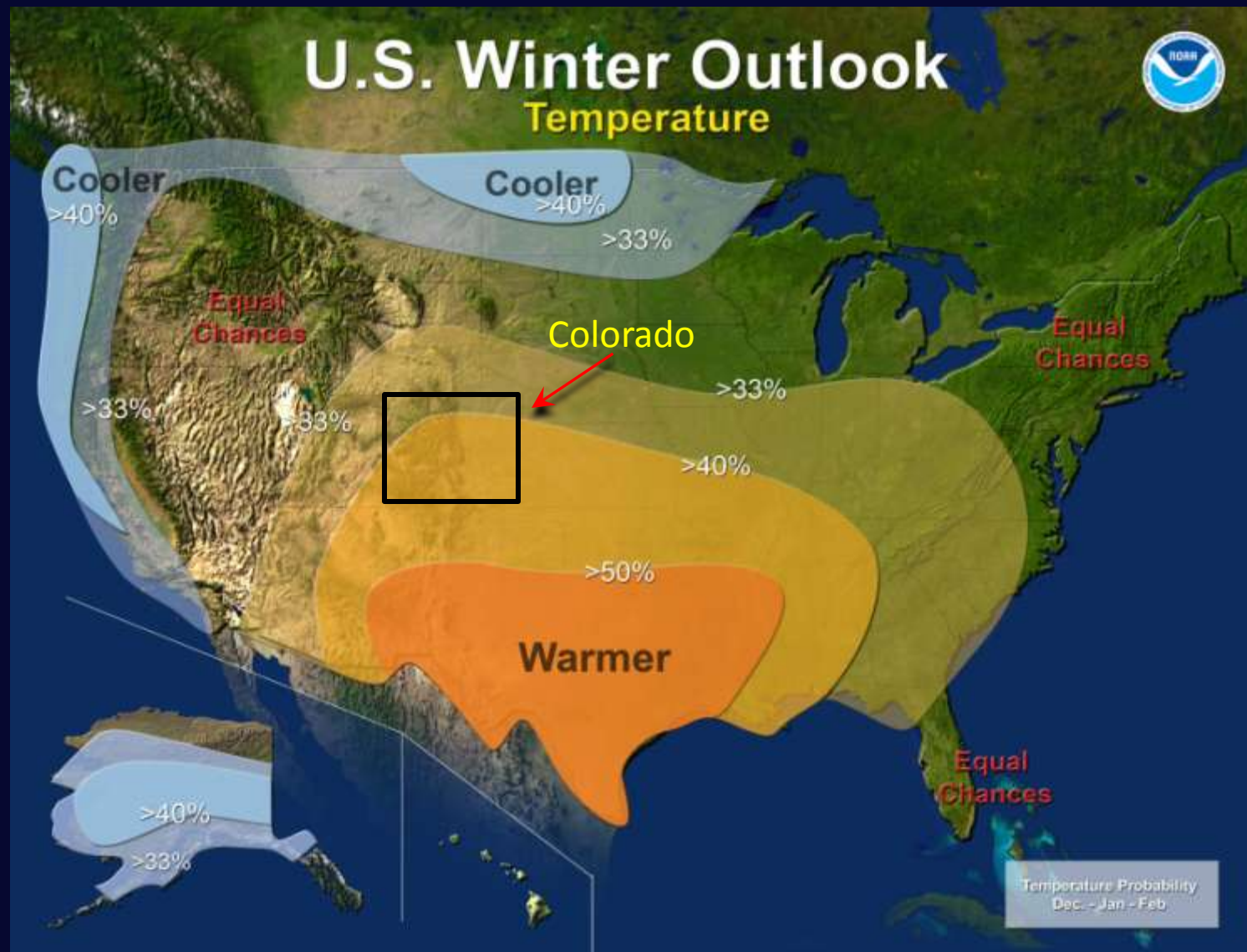
Not Yet
Available

Warm Episodes - El Niños (in RED): ONI 0.5 and above

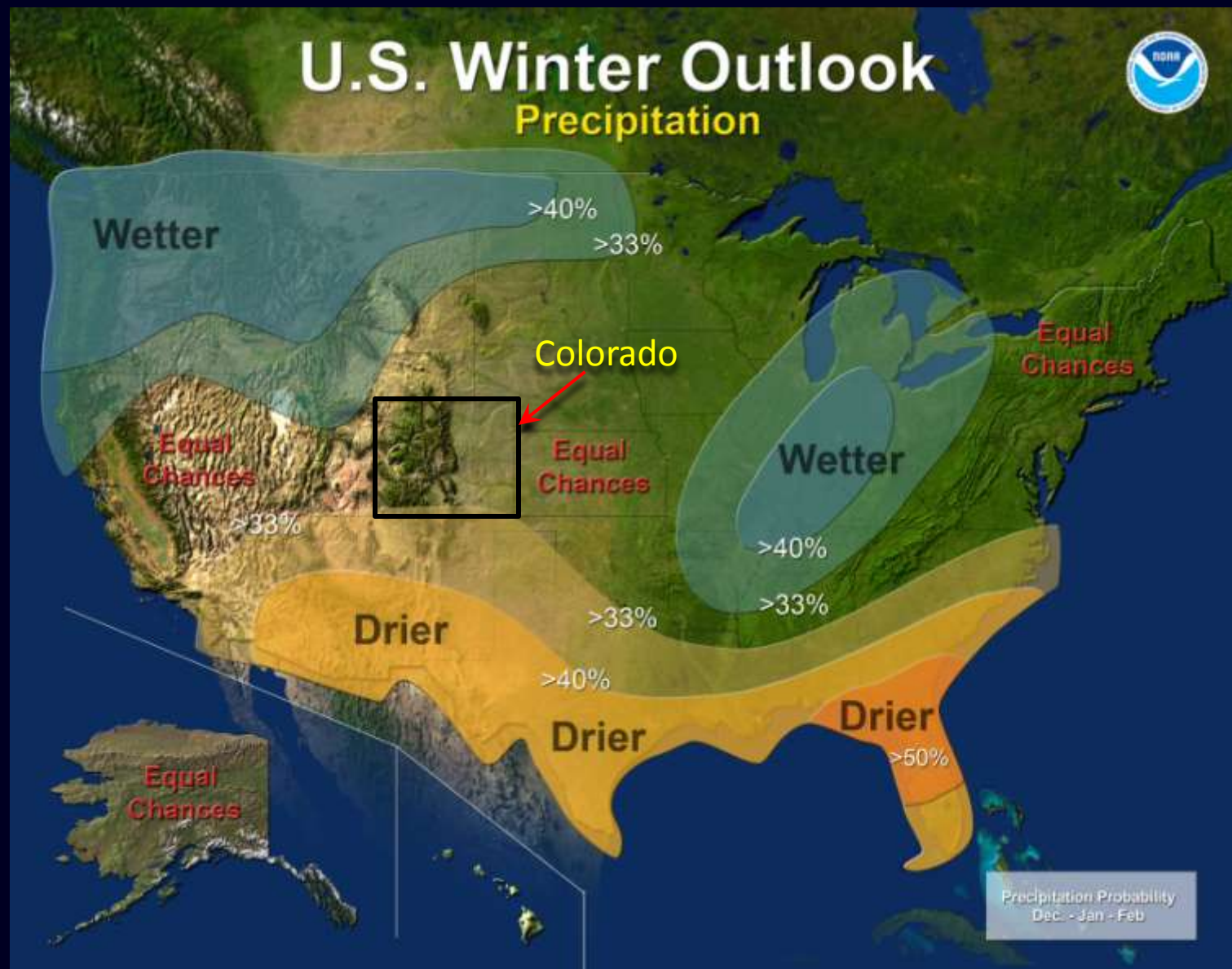
Cold Episodes - La Niñas (In Blue): ONI of -0.5 and below

Neutral Episodes -non-ENSO (In White): ONI above -0.5 and below 0.5

National Outlook for
the Upcoming 2010-2011
Winter Season Released
by NOAA's Climate
Prediction Center

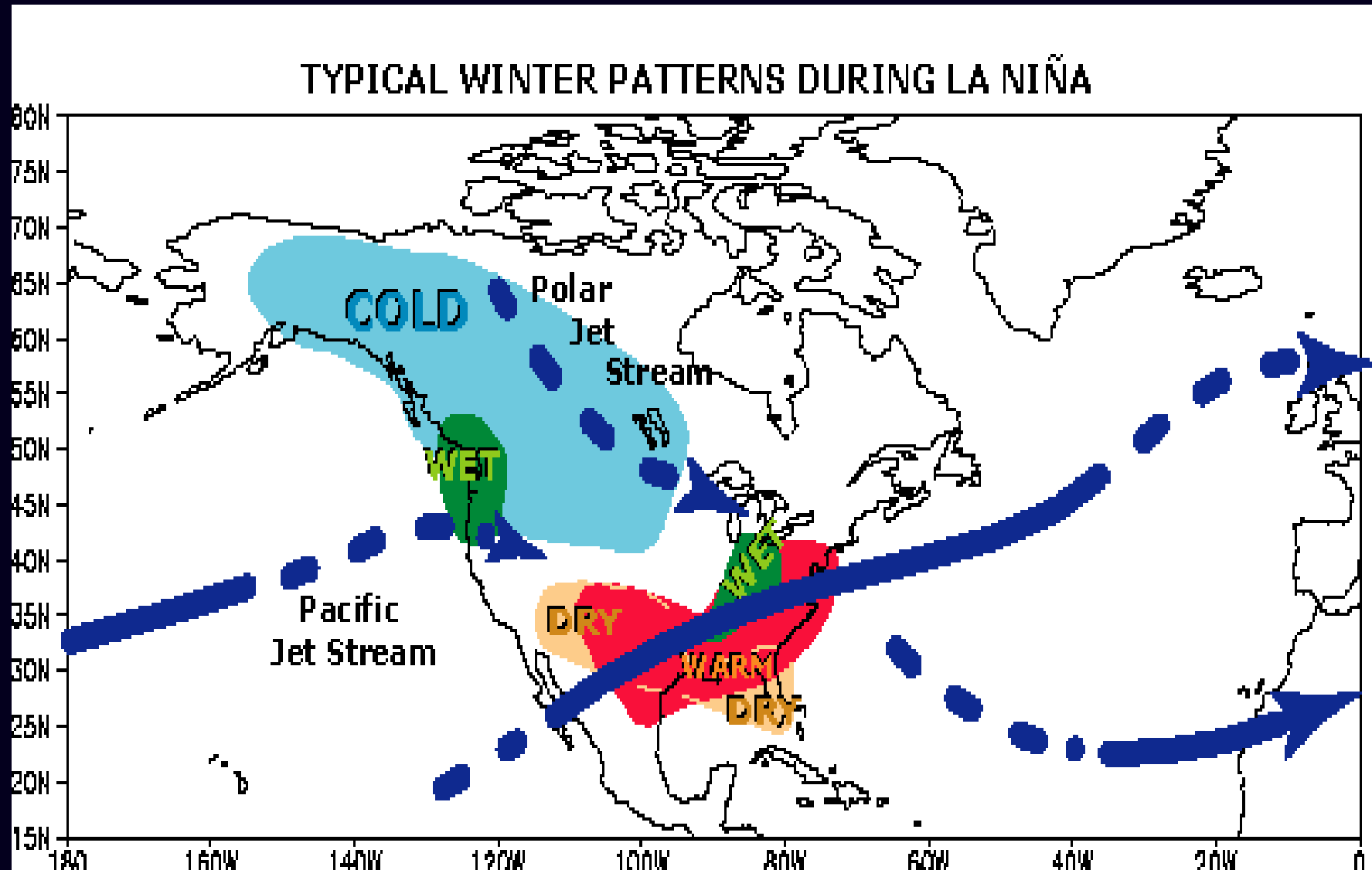


Temperature Probability for the 3-month climate season
of December, January and February
Issued by NOAA's Climate Prediction Center



Precipitation Probability for the 3-month winter season of
December, January and February
Issued by NOAA's Climate Prediction Center

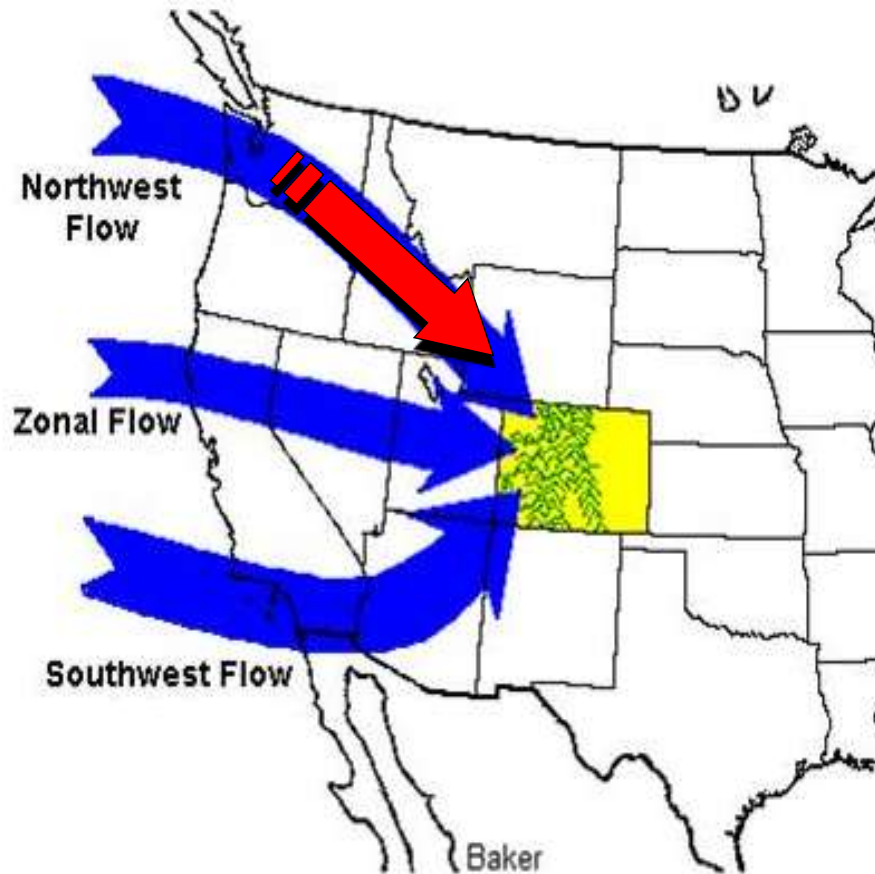
Typical North American Temperature, Precipitation and Jet Stream Patterns during La Niña Winters



Source: NOAA/Climate Prediction Center

The Role of the Jet Stream on Colorado Weather

The Jet Stream and It's Influence On Colorado Weather



A northwest jet stream originating over the Pacific Northwest typically produces above average precipitation and below average temperatures across western Wyoming and northwest Colorado during the winter season of moderate to strong La Niñas

This same jet stream pattern is often responsible for below average precipitation , above average temperatures and periods of strong and gusty downslope winds (Chinook and Bora wind events) east of the Continental Divide , particularly during the fall and spring of La Niña episodes.

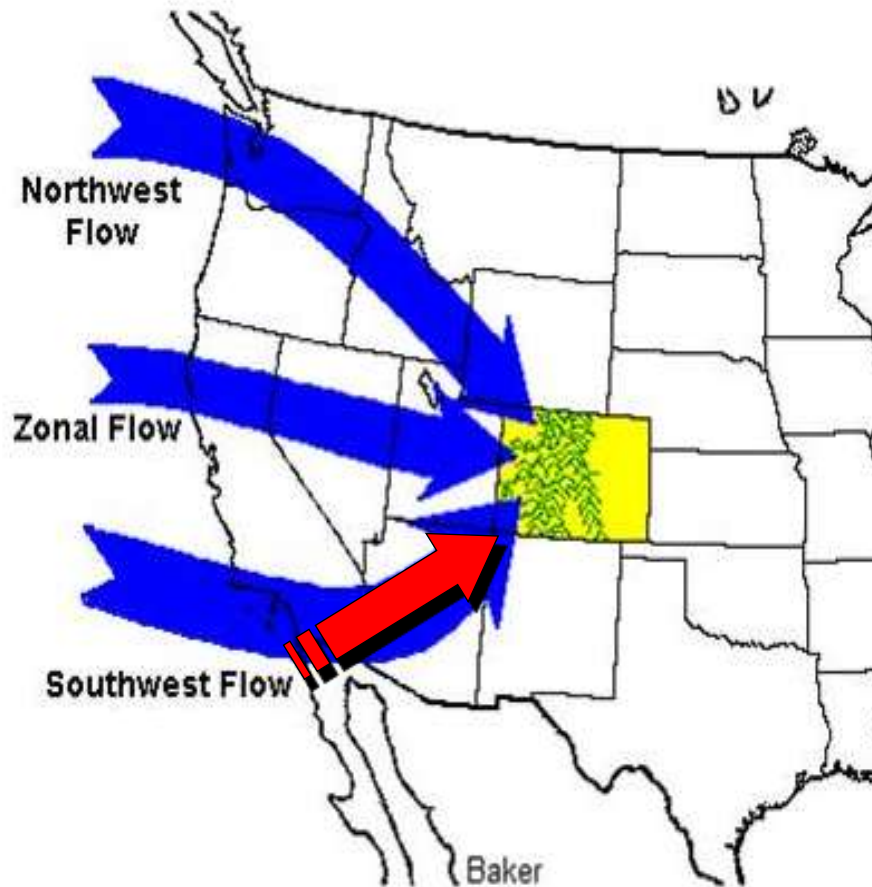
The Jet Stream and It's Influence On Colorado Weather



A westerly or zonal jet stream often results in above average winter and springtime precipitation, increased cloud cover and a greater number of valley fog days across western Colorado.

This same westerly jet stream pattern is also associated with below to much below average precipitation, very low humidity and above average temperatures in areas east of the Continental Divide. There is also an increase in the number of potentially downslope wind events (mainly the warmer Chinook type winds) during the spring of La Niñas.

The Jet Stream and It's Influence On Colorado Weather

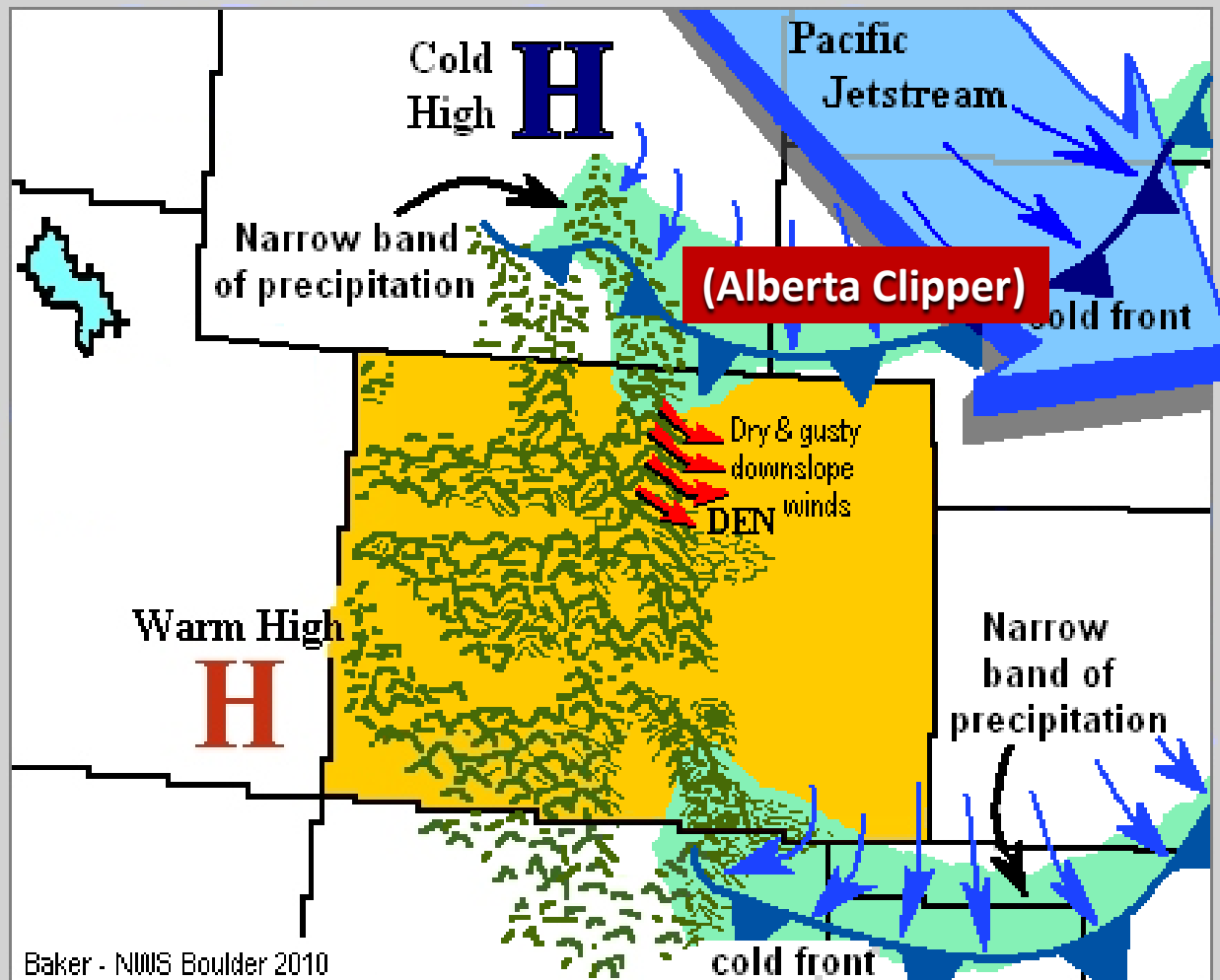


Finally, a southwest jet stream originating over the Desert Southwest is often associated with above to much above average precipitation and lower than average daytime temperatures for the Four Corners region, particularly across southwest and south central Colorado during late winter and spring of El Niño episodes.

This same jet stream pattern typically produced above average precipitation and warmer than average nighttime temperatures in areas east of the Continental Divide, particularly during the late winter and spring of moderate to strong El Niños.

Dominant Weather Patterns
Across Colorado
During Moderate to Strong La Niñas.

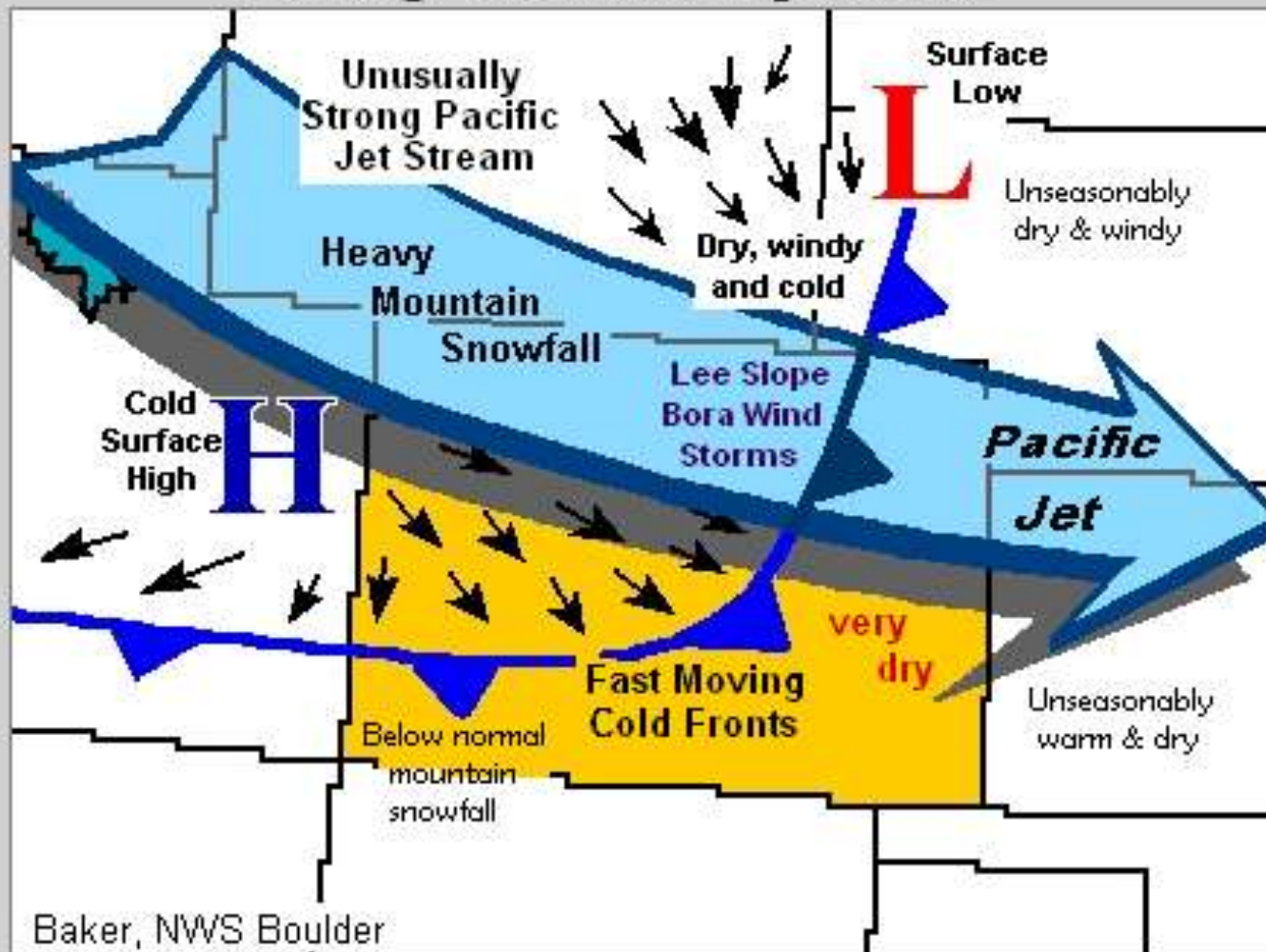
Mean Position of the Pacific Jet Stream During the Autumn Season of Moderate to Strong La Niña Episodes



During moderate to strong La Ninas, eastern Colorado often sees an increase in the number of “dry” cold fronts during the autumn season. These fast moving frontal systems, sometimes referred to as “Alberta clippers” are driven southward down the leeside of the Rockies by a strong Pacific jet stream diving southeastward over the northern Great Plains. These shallow fronts typically produce only light precipitation of short duration, and are often accompanied by strong and gusty northerly winds, and a sudden often large drop in temperature.

Whereas, western Colorado will feel little, if any impact from these high plains clipper systems.

Mean Position of the Pacific Jet Stream Late Autumn and Winter of Moderate to Strong La Niña Episodes

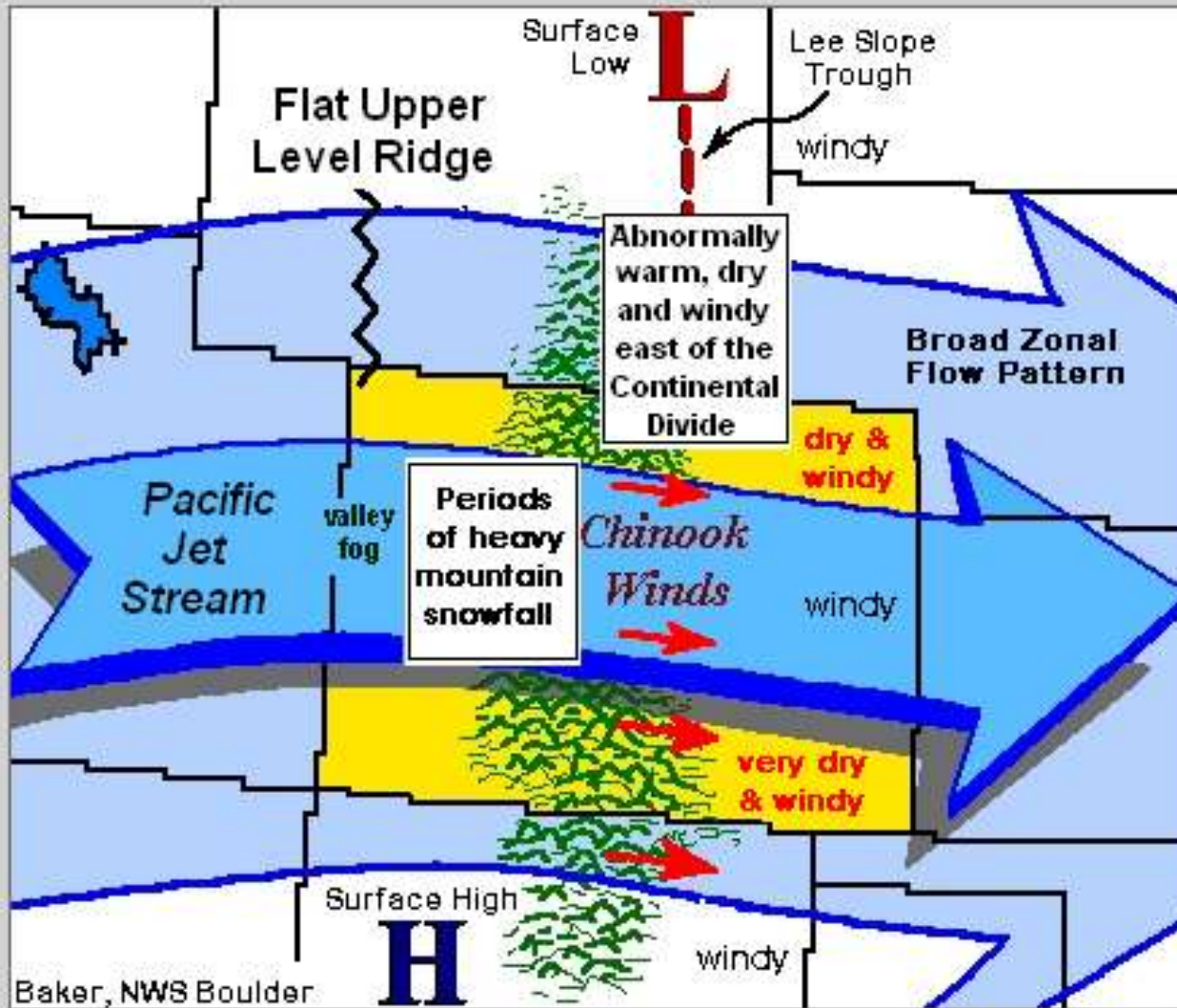


As the dominant west coast upper level high pressure ridge begins to flatten and weaken, a strong Pacific jet stream shifts southward, assuming a northwest-to-southeast trajectory.

This often results in periods of moderate to heavy precipitation (mainly snowfall) and strong and gusty surface wind across northwest and north central Colorado.

Areas east of the mountains typically remain relatively warm, windy and quite dry.

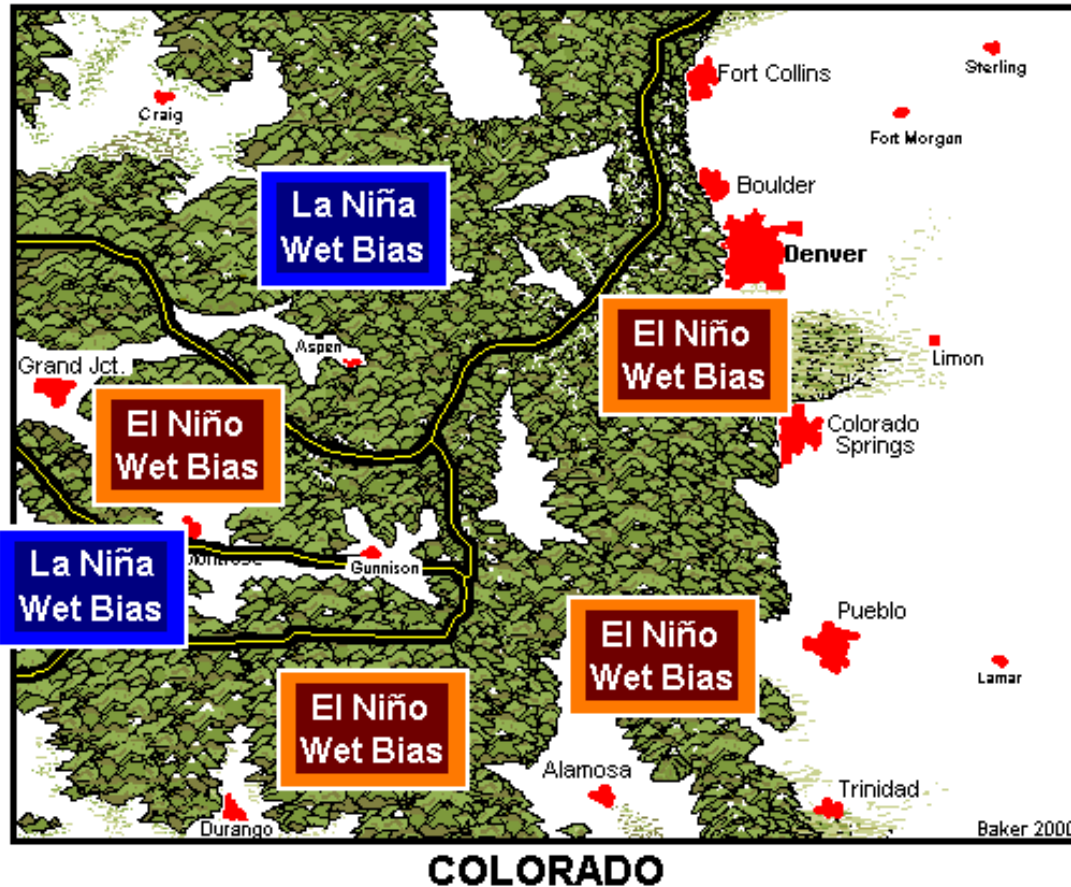
Mean Position of the Pacific Jet Stream During the Spring of Moderate to Strong La Niña Episodes



During late winter and spring of moderate to strong La Niñas, the prevailing flow aloft will often assume a more zonal or westerly component. This flow tends to be warmer and drier, however mountain areas in Colorado generally along and west of the Continental Divide may still see periods of significant precipitation (mainly in the form of snow), along with considerable valley fog and cloud cover.

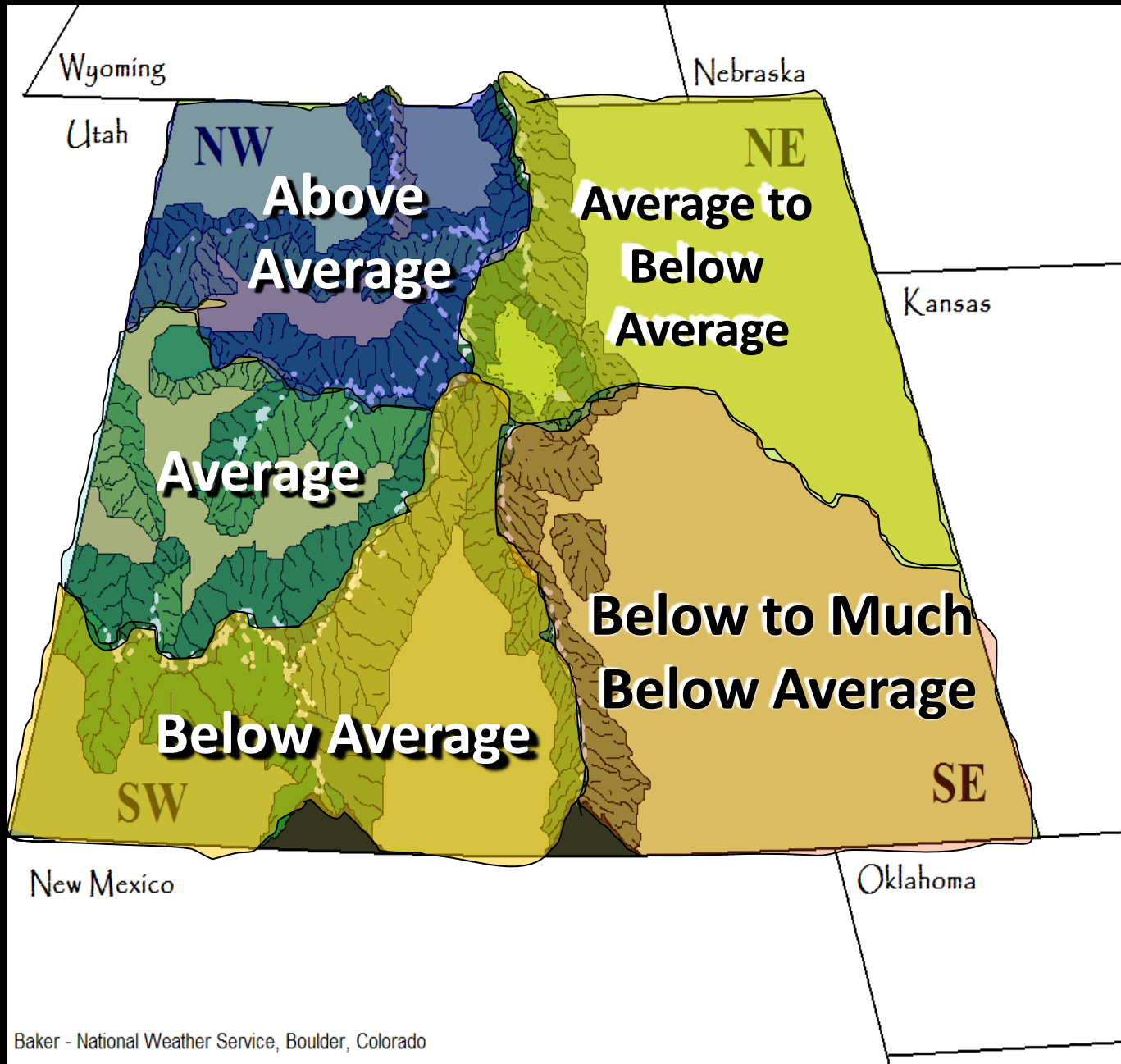
Conversely, areas east of the Continental Divide will typically see abnormally warm and dry conditions, as well as periods of gusty and potentially damaging down slope (Chinook) winds.

Wintertime Precipitation Biases Typically Observed in Colorado During Moderate to Strong La Niñas and El Niños



During La Ninas of at least moderate strength, the dominant Pacific jet stream (storm track) pattern will often produce above average wintertime precipitation across northwest Colorado, as well as on the west-northwest facing slopes in the central mountain ranges around Vail and Aspen, and on the northwest aspects of the San Juan Mountains in southwest Colorado.

Whereas, during moderate to strong El Ninos, a several state shift southward in the mean position of the wintertime Pacific jet stream and storm track produces a wet bias across southern and eastern Colorado, especially for south and east facing aspects in the San Juan and Sandre de Cristo Mountains in southern Colorado, as well as for the northern Front Range and southeast plains of Colorado.



In Summary...

During moderate to strong La Niñas, west central and northwest Colorado typically receives **AVERAGE to ABOVE AVERAGE** precipitation (rain and snow) during the winter and early spring.

While southwestern and eastern portions of Colorado typically see **BELOW to MUCH BELOW AVERAGE** precipitation (rain and snow) as a general rule during the fall, winter and spring of moderate to strong La Niñas.

Potential Impacts of La Niña on the Colorado Front Range



Above Average
Temperatures



Below Average
Precipitation
and Even
Drought



Lower Water Levels on
Area Lakes and Reservoirs



Increased Wildland
Fire Danger

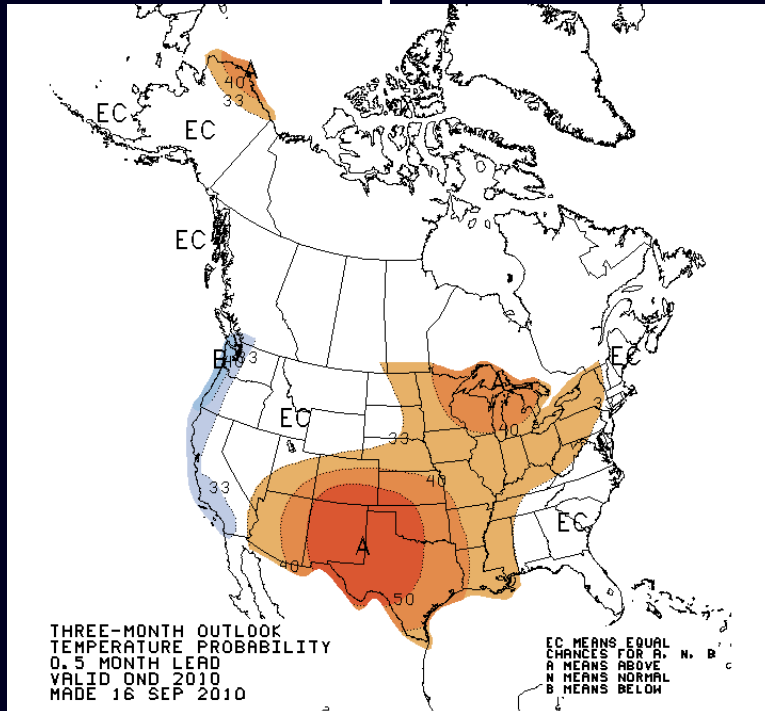


Damaging Downslope
Wind Storms

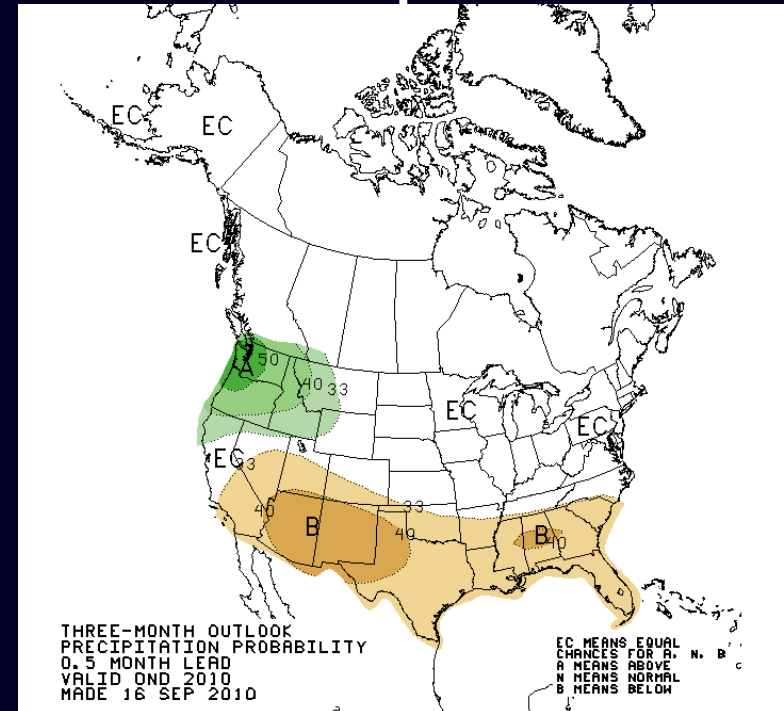
U. S. Seasonal Outlooks

October - December 2010

Temperature



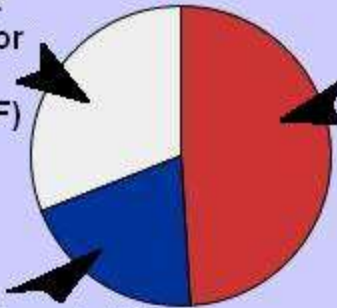
Precipitation



The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, the ENSO cycle.

**November-December-January 2010-11
Temperature Outlook for Denver, CO**

A 31 percent
probability for
near normal
(31.9F - 34.6F)

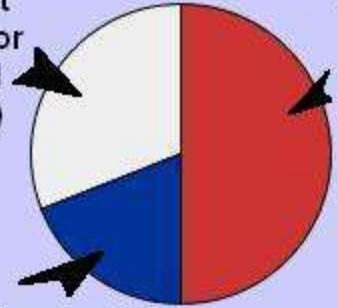


A 49 percent
probability for
above average
temperature
(higher than
34.6F)

A 20 percent probability
for below normal temp.
(lower than 31.9F)

**November-December-January 2010-11
Temperature Outlook for Boulder, CO**

A 31 percent
probability for
near normal
(32.6F - 35F)



A 50 percent
probability for
above normal
temperature
(higher than
35F)

A 19 percent probability
for below normal temp.
(lower than 32.6F)

**November-December-January
2010-2011
Temperature
Outlook for Denver and
Boulder, Colorado Issued
by the
Climate Prediction Center**

Summary

La Niña conditions are present across the central and eastern tropical Pacific Ocean.

Equatorial SSTs are as much as 2 to 4 degrees C below average from the Date Line eastward to the South American coast.

Recent equatorial Pacific SST trends and model forecasts indicate La Niña will continue at least through the spring of 2011.

The current La Niña is forecast to produce above average temperatures and below average precipitation across most of Colorado...specifically southern and eastern portions of the state at least through the upcoming winter season.

Meanwhile the northwest and north central portions of Colorado are in line to see above average precipitation (snowfall) and below average temperatures, particularly during the latter half of this winter and perhaps through the spring of 2011.